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**STRUCTURAL ADJUSTMENT AND IRRIGATED
AGRICULTURE IN SENEGAL**

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STRUCTURAL ADJUSTMENT AND IRRIGATED AGRICULTURE IN SENEGAL

Philip Woodhouse and Ibrahima Ndiaye

1. INTRODUCTION

By the start of the 1990s, structural adjustment programmes linked to IMF and World Bank lending had been implemented by the government of Senegal for ten years. The IMF strategy has tried to reduce budget and trade deficits by reducing consumption, particularly public consumption, and by stimulating exports through shifts in domestic price policy. The series of three World Bank structural adjustment loans have also emphasised price policy and reduction in state expenditure, particularly through restructuring or abolition of parastatal organisations. These policy orientations were embodied in the Senegalese government's Nouvelle Politique Agricole (NPA) published in 1984, which established guidelines for four main areas:

1. Transfer of certain parastatal functions, such as crop storage, to producers - *responsabilisation paysanne* - linked to a reorganisation of cooperatives and farmers groups;
2. Transfer of the agricultural input supply system from parastatals to the private sector;
3. " Overall reduction in the activities of parastatal development agencies;
4. Changes in price policy to remove all subsidies on agricultural inputs, and to establish domestic consumer prices at levels high enough to provide protection for domestic cereals production against imports.

The price policy for cereals was set out in the Plan Céréaliier in 1986, whose objective was to increase domestic food production from around 50% of national requirements in the mid 1980s to 80% by the end of the century. To achieve this, the Plan proposed increased producer prices, an increase

in consumer prices to allow a minimum 25% protection rate for domestic cereals against imported cereals, and an increase of 75% in cereal yields through higher input use (Commander et al, 1989).

The most important element of protection was for domestic rice production. Rice was the largest component of food imports: constituting 77% of the 453,000 tons average annual commercial cereals imports between 1981 and 1984. Rice is a significant and increasing part of food supply in both urban and rural areas.

The emphasis on increasing rice production is heavily reliant on developing irrigation for food production. To this end, 75% of the agricultural investment budget in 1986-89 was to be used for irrigation development. Of this, two thirds, constituting 46% of all agricultural investment, was to be spent in the Senegal river valley (Afrique Agriculture, 1986). The government's emphasis on the Senegal river valley rests on the belief that conditions for irrigated production would be dramatically improved by two factors:

- *I'Après-barrage*: the completion of two dams, one at the top of the river basin, at Manantali in Mali, and the other close to the estuary at Diama, which would allow year-round irrigation throughout the valley;
- *le Désengagement*: the withdrawal of the state from the supply of agricultural inputs and services to allow provision through commercial markets.

With the completion of the dams in 1987, *I'Après-barrage* became a reality. Thus the rapid growth anticipated in irrigated food production is now seen to depend on the pace of state withdrawal. This paper describes the extent of this withdrawal in early 1989. Based on field work carried out January - March 1989, it identifies emerging trends in irrigated farming and uses these trends to assess the effect of the "disengagement" process on agricultural output.

We continue to use the term 'disengagement' in this paper to describe the process of state withdrawal. In other Anglophone work, the terms 'turnover' and 'privatisation' are both in use to describe different components of this process. 'Turnover' is generally used to describe the delegation of water management duties to local institutions (and sometimes credit, marketing and fertiliser coordination). 'Privatisation' is the delegation of responsibilities to the private sector.

2. IRRIGATION IN THE SENEGAL RIVER VALLEY

The Senegal river flows along the southern limit of the Sahara Desert, forming the frontier between Senegal, on the south bank, and Mauretania on the north bank. In 1972 the governments of Mali, Senegal and Mauretania formed a river basin development organisation (OMVS - Organisation pour la Mise en Valeur de la Vallée du Sénégal) which, with foreign financial and technical assistance, has drawn up plans for a total of over 300,000 ha of irrigated agriculture in the valley, of which 224,000 ha are on the Senegalese bank.

Farming conditions vary considerably along the length of the river, due to climate and topography, but for the purposes of this paper we distinguish only three regions on the Senegalese side:

the *delta*, which extends from the coast to a point a few km upstream from Dagana. Before the construction of the Diama barrage seawater intruded as far upstream as Podor during the dry season, and the resulting salinity of much of the soil made crop cultivation impracticable. The Delta was therefore sparsely populated before the advent of irrigation.

the *middle valley* from Dagana to Dembakane, where traditional flood-recession agriculture has centred on the use of the *cuvettes* - low-lying parts of the floodplain which are covered for a month or more by the annual flood of the river. Customary land rights on the *cuvettes* are distributed between three main caste groups, involved, respectively, in fishing, pastoralism and crop cultivation. Access to the *cuvettes* is tightly controlled through village hierarchies, as described by Schmitz (1986) and Bleeker (1987).

the *upper valley*, from Dembakane to the Senegal-Mali frontier. The valley is narrower than in the middle valley and opportunities for flood-recession farming are more limited, but higher rainfall allows rainfed millet and groundnut cultivation on lighter soils at the valley margins. Detailed accounts of farming by Soninké communities in this part of the valley have been given by Adams (1977, 1985).

The history of irrigation development in the Senegal river valley has been set out elsewhere (OMVS, 1984; Engelhard et al, 1986; Adams, 1981; Diemer and van der Laan, 1987). This irrigation may be regarded as having one of two distinct origins.

Firstly, large-scale schemes of 1,000 ha or more were established to grow rice for the national market. These schemes were originally constructed in the delta in the 1960s to grow rice under partially-controlled flooding. The characteristics of the Senegal river flood proved too irregular, however, and in the 1970s large electric pumping stations were introduced for improved water control. Land distribution had been carried out according to the criteria of 0.5 ha per *actif*. As a result household units frequently had total holdings of 1.5 ha, rising to several hectares in some cases. The relatively large landholdings require mechanised tillage, a generalised use of herbicides for weed control, and seasonal hired labour during harvest.

Elsewhere, small-scale schemes (PIV - Périmètres Irrigués Villageois) were established from 1975 onwards, each covering an area of 20 - 50 ha. The PIVs were typically constructed on the levees of the main courses of the river (thus avoiding conflict with traditional land rights in the *cuvettes*), which had soils of a lighter texture than the *cuvettes*. Each perimeter was irrigated from the river by a float-mounted diesel pumpset, the running costs (fuel, spare parts, operator) of which were met by those cultivating the irrigated plots. The size of individual holdings on PIVs varies between 0.1 and 0.5 ha, but is most commonly 0.2 - 0.3 ha, and practically all operations are carried out manually, including tillage.

Except for one commercial sugar plantation, by the 1980s all the irrigated areas were divided into smallholdings, allocated to individual farmers by the irrigation management body. For the PIVs, 'management' was the village authorities; the state corporation SAED (Société d'Aménagement et d'Exploitation des terres du Delta du fleuve Sénégal) managed the large-scale schemes. SAED, formed in 1965, played a central role in both types of scheme, however, by undertaking design and construction of the irrigation work, provision of technical and input supply services including tractor hire, operation of the large pumping stations (large perimeters), and supply and maintenance of small pumpsets (PIVs). Thus, farmers' irrigation organisations have been shaped by conditions in which the state had responsibility for the supply of key factors of production, and the withdrawal of the SAED from this responsibility - *le disengagement* - implied a change in the functioning of the farmers' irrigation organisations.

On both types of perimeter the direct production costs were covered by credit from the supplier of inputs and services - also SAED. By 1984 the accumulated debt arrears were 255 million fr CFA¹ in the valley as a whole

¹ \$US 1 = 449 fr CFA (1985); \$US 1 = 310 fr CFA (1989).

(SAED, 1986), with the indebtedness running at a higher level on larger perimeters. This large unpaid debt was a factor in persuading the state to withdraw from input and credit provision as part of the structural adjustment programme.

However, two sets of improvement measures, aimed at circumventing the perceived weaknesses of both small- and large-scale irrigation, were introduced before the decision to withdraw. Firstly, "intermediate" schemes were created to provide larger irrigated areas for participants of the PIVs of the middle valley, where small irrigated plots were often barely sufficient to cover subsistence needs.² Secondly, the success of village irrigation organisations in managing PIVs was extended to larger schemes by breaking up cooperatives which had previously grouped about 400 participants into small *Sections Villageoises* (SV), with a greater degree of managerial autonomy. The SV was further subdivided into *groupements*, which were to be the unit of irrigation management. Despite modifications during the SAED withdrawal, these initiatives continue to exert influence over the evolution of irrigation in the Senegal river valley.

3. LAND RIGHTS IN IRRIGATION MANAGEMENT

With the promulgation of the land reform law in 1964, some 97% of the land in Senegal was nationalised, and traditional land rights were no longer recognised. Instead, the right to use land in rural areas was to be allocated by the newly-formed "rural communities" through their elected rural councils. The new law aimed to improve equity of access to land through allocation by an elected body. In practice, members of traditional landholding families were often elected to the rural councils, and "the modern law practically reinforced the local standing of the traditional chief by conferring upon him a new state function" (Engelhard et al, 1986).

However, two further provisions of the law have influenced the evolution of irrigated land rights. Firstly, the state can declare an area '*zone pionnière*', in which the jurisdiction of the local rural councils is suspended, in order to implement projects deemed to be in the wider national interest. A second provision stated that, while a rural council could reallocate land that it

² Although this would require extension of the PIVs from the levees to the more extensive, but flood-prone *cuvettes*, with attendant increases in cost (for flood-protection and mechanisation) and conflict with customary land tenure.

considered under-utilised, such reallocation required compensation to be paid by the new user(s) for any buildings or infrastructure on the land.

In 1965 the delta was declared *zone pionnière* under the jurisdiction of SAED, extended to the entire southern side of the valley in 1980. In practice SAED found it expedient to accommodate local rural councils when they defended traditional land rights. The strength of such rights varied across the valley. In the delta, where historically population was sparse and where subsequent immigration gave rise to heterogeneous communities, traditional land rights were weak. In contrast, the villages of Halpulaar (Toucouleur) people in the middle valley and of Soninké in the upper valley were long-established and local land rights were well defined. In these areas establishment of irrigation infrastructure was sometimes opposed by traditional landholders who saw it as an irreversible transfer of land tenure. With the arrival of *l'après-barrage* this identification of irrigation with land tenure has assumed increased importance throughout the Senegal river valley.

In the middle and upper valley the potential for conflict over land rights was reduced because the PIVs were generally situated on the levees of the river to facilitate pumping, on land that was of less importance in traditional farming than the low-lying *cuvettes*. Once irrigation was established, rural councils or village councils played a central role in deciding the allocation of irrigated plots. However, redistributive effects are biased.

Diemer and van der Laan (1987) argue that in the Halpulaar villages of the middle valley the access to irrigated plots is more egalitarian than traditional land tenure. In particular, their data shows that socially disadvantaged castes descended from slaves, who had no traditional land rights, have access to irrigation comparable to that of descendants of slave-owning castes. However, in the same villages women have not been so fortunate. Gaudet (1988) states that by the 1970s the scope for independent cultivation by Halpulaar women had diminished to such an extent that their traditional economic autonomy had been replaced by dependence upon their husbands, for whom they provided labour for sowing and harvesting the flood-recession sorghum crop. Diemer and van der Laan (1987) cite evidence that, despite massive migration of men from the middle valley, the proportion of work done by women in the sorghum crop (29 - 33%) was no greater in 1978 than in 1957. Their figures also indicate, however, that the proportion of work done by men in irrigated rice is lower (49%) than in sorghum (67 - 71%). Thus a switch from flood-recession sorghum to irrigated rice, such as took place in the 1970s and 80s, would indicate an increase in the proportion of agricultural work done by women.

In the PIVs of the middle valley, women have no rights to cultivate irrigated plots independently of their husbands. At Podor, also in the middle valley, a proposal in 1984 to allocate irrigated plots equally to the 57 male and 61 female participants of the Niandane III perimeter, by the Senegalese NGO, OFADEC, was opposed by the local rural council in favour of an allocation to heads of households (Engelhard et al, 1986). The matter appears to have been resolved by allocation of plots to male participants only. When visited in 1989, of the 56 participants cultivating the perimeter, none were female.

In Soninké communities of the upper valley women appear to have retained their independence as cultivators to a greater degree, largely through growing rainfed groundnut on the *died* soils at the outer margins of the valley (Adams, 1985), and this is reflected in their participation in PIVs as holders of irrigated plots in their own right. Thus, Blijdorp (1987) found that women accounted for some 60% of the participants in a sample of 13 PIVs in the Bakel area. However, women's plots tended to be smaller than those of men and accounted for only 40% of the irrigated area. More important, perhaps, all irrigation management was carried out by men, even on women's plots.

Restrictions placed on women's independent access to irrigated plots on the PIVs of the middle and upper valley appear to have promoted the formation of women's groups to develop women's irrigated agriculture. These initiatives have centred on the establishment of small areas of high-value vegetable crops. These "gardens" have often been established close to the river, from which water is carried in buckets to the crops. External support specifically for women's projects has raised the possibility of women acquiring pumpsets and operating PIVs of their own, and a perimeter of 12 ha has been established in this way by 232 women at Moudery, near Bakel (Blijdorp, 1987). Elsewhere, on the He à Morphil external funding has provided pumpsets to women's groups who have thus been able to greatly expand the size of their vegetable-growing areas. Ultimately, however, the development of irrigated farming by women's groups depends upon the willingness of the men on village and rural councils to allocate land for this purpose.

In the delta, there is little to indicate that women's access to irrigation is any greater than elsewhere, but this issue is somewhat masked by that of access according to age. In the middle and upper valley migration has been the established source of income for young men during the past 40 years. In the delta, however, long-distance migration is less common among young men. As a result, there is greater pressure among the youth of the delta to obtain access to irrigated land. Yet this pressure finds little relief in the tenure

arrangements on the large-scale irrigation schemes. Land allocated to heads of family groups according to the number of *actifs* within the family has remained unchanged. Holdings are therefore concentrated in the hands of older men, who make up the membership of the *Sections Villageoises*, providing younger men little scope for cultivation other than on their older relatives' land. This situation has motivated the development of youth organisations, or *foyers*, aimed at providing independent access to irrigated farming for young people. The *foyers* have attracted support from foreign development agencies, particularly NGOs. These agencies have assisted expansion of small-scale irrigation in the delta using the same technology as the PIVs of the middle and upper valley. With the decline in wage opportunities elsewhere, the numbers of young men seeking irrigable land in the middle valley is also increasing. The case noted above, of the OFADEC project at Niandane, Podor, indicates that while allocation of irrigable land to younger men may conflict with the immediate need of heads of households to retain control of 'family' labour, rural councils seem more likely to make such allocations than to allocate land to women.

As the dams at Diama and Manantali neared completion, considerable publicity was given to the improved potential for year-round irrigation. In line with the market liberalisation measures of the Nouvelle Politique Agricole, the government has encouraged individuals and groups to invest in irrigated farming. Since 1984 such investment has been made possible through the allocation of land in the delta (by rural councils) to wealthy individuals, and to associations of farmers (*Groupements d'Intérêt Economique* - GIE). As in the case of the *foyers*, these investments have taken the form of "PIVs" irrigated by small diesel pumpsets. The resulting proliferation of small-scale irrigation in the delta has apparently accelerated during the period of SAED disengagement.

4. THE DISENGAGEMENT OF SAED

4.1 The Programme

The Nouvelle Politique Agricole stated that the SAED would begin a phased programme to terminate its activities over a period of five years in order that these be taken over by "private operators and peasant organisations" (Afrique Agriculture, 1986). In the first stage, from 1984 to 1987, SAED was to withdraw from the provision of credit, the supply of inputs, and rice marketing. Agricultural credit was to be taken over by the Caisse Nationale du Crédit Agricole du Sénégal (CNCAS), a mixed state and commercial bank set up in 1984. The supply of fertilisers, pesticides, and agricultural machinery was left to commercial enterprises. Marketing

of paddy was to be the responsibility of the *Sections Villageoises* (SV), SAED merely paying for paddy delivered to the rice mills.

Preparations would be made to withdraw, in a subsequent phase, from the operation of the rice mills, machinery repair and maintenance, and from the operation and maintenance of the primary infrastructure on the large canal systems. A first step in these preparations was the formation of four autonomous management units to run these continuing SAED activities until they could be handed over to commercial operators.

4.2 Credit

Although CNCAS was established in 1984, it was not until 1986 that a protocol was signed between CNCAS and SAED establishing the conditions for farm credit. Meanwhile SAED made increasingly drastic efforts to recuperate accumulated debts from peasants on large-scale perimeters, culminating in the refusal to supply water and the effective closure of over 5,500 ha of the irrigation system in 1986 (Dieye, 1985; SAED, 1986; OMVS, 1987). The rainy season of 1987 was the first in which CNCAS credit was used to finance input purchases, with a total of 110 million fr CFA credit extended to farmers' groups in the delta considered to be creditworthy. Of this about half went to SV cultivating the large-scale perimeters, with the remainder going to 12 *Groupements d'Intérêt Economique* (GIE). These credits, together with smaller loans advanced for growing cool season tomatoes and a dry season rice crop, were all repaid in full, a total of 174 million fr CFA over the whole 1987-88 agricultural year. In the following rainy season of 1988, a total of 550 million fr CFA was advanced in credit for the rice crop, of which only 126 million was to farmers in the middle valley through CNCAS branches opened in Podor and Matam. The remaining 424 million was used in the delta, with approximately 40% going to SV, 40% to GIE, and 20% to *foyers*.

The terms of CNCAS credit are that, firstly the borrower must deposit 15% of the value of the loan, secondly that interest is paid at 14% on the loan, and thirdly that farmers' organisations are collectively responsible for repayment. Thus each organisation must recoup debts from its individual members. All applications for CNCAS credit must first be checked by the local SAED delegate and must carry written SAED approval. Given the large number of organisations in debt to SAED, the CNCAS loans have frequently been granted on the condition that outstanding debts to SAED be repaid over a three year period. Some evidence emerged from interviews, however, that repayment priorities were likely to be given to (current) CNCAS loans, and that, if these were repaid, CNCAS was unlikely

to press hard for the repayment of SAED arrears. At the time that field work was undertaken, final records of credit used and repaid were not available. Analysis of credit notes used to pay suppliers of goods and services (who later cash these at CNCAS), indicate, however, that about 75% of the credit agreed by CNCAS with farmers organisations in the delta was actually used, and that about 40% of this was used to pay for machinery hire, 45% for fertiliser, and the remainder for herbicide.

As shown, CNCAS credit plays a larger role in financing input purchase in the delta than elsewhere. This is for a number of reasons. Firstly, following the announcement of SAED withdrawal, a number of foreign development agencies³ involved in assisting irrigation in the middle valley, financed a fund of working capital for each farmers irrigation group within their project area, thus reducing the need for CNCAS credit in some areas. Secondly, alternative income sources, from livestock sales and from non-farm sources had previously played a significant role in financing input purchases, so that withdrawal of SAED credit was less important. Thirdly, mechanised tillage is not generally used on PIVs so that direct production costs are lower. Finally, on small-scale perimeters payments were often spread throughout the growing season because inputs were only purchased when they were needed.

Withdrawal of SAED from the supply of inputs such as fuel and fertiliser, seems likely to make credit more important, however, because although commercial suppliers may have facilities for storing fuel (where they also sell to transport operators, for example), it is unlikely that they will store fertiliser in advance of sales (Woodhouse and Ndiaye, 1990). Absence of local fertiliser stocks will mean that groups must order all their inputs from traders in advance, tying up more cash for the whole growing season. However, long lines of communication between the CNCAS in St Louis and the villages of the middle valley have caused delays in the release of credit. As a result of delays in CNCAS credit, one village irrigation group contacted, that of Boke Mbaibe and Salsalbe, had sought and obtained an alternative source of working capital by negotiating to use cash deposits made under the World Food Programme (nominally reserved for capital investment projects) for this purpose. However, not all farmers in the village were prepared to accept the risk of paying for a whole season's fuel and fertiliser in advance, and only 10 ha out of the total perimeter area of 18 ha was to be cultivated. This highlights the important point that the

³ FED-European Community in Podor, KFW-Germany in Nianga, Netherlands government in Ile à Morphil.

withdrawal of SAED has shifted the burden of risk decisively onto farmers. It may also be noted that, since traders supply no goods on credit, the CNCAS loans paid for (in the form of interest) by farmers effectively increase traders' sales at no cost or risk to traders themselves.

43 Input Supplies

SAED stopped supplying pesticides immediately in 1984, as an "experiment" to assess the capacity of commercial suppliers and farmers to take over. The result was a collapse in pesticide use with serious reduction in yields, particularly in the tomato crop in 1985-86 (SAED, 1986). The following year SAED began supplying pesticides again, and continued to do so until the 1988 rainy season, which was the first occasion on which fertiliser and pesticides were supplied by commercial enterprises.

Fertilisers used in the principal (rice) crop in the Senegal river valley are urea (46% nitrogen) and diammonium phosphate (DAP: 18% nitrogen, 46% P₂O₅). Although widely claimed that the withdrawal of SAED would significantly reduce the amount of fertiliser applied by farmers, with negative effects on rice yields, available evidence suggests that this has not happened in general terms. However, at the level of individual farmers it seems that fertiliser rates depend on farmers' assessment of the other constraints on crop growth. Thus, where growing conditions are good (e.g. SV Thilene, in the Lampsar perimeter) fertiliser rates are above those recommended, but where irrigation is problematic, as in the case of the SV Tellel Peuhl, who occupy land at the tail-end of the Grand Digue-Tellel-Kassak perimeter, fertiliser use is less than half that recommended, and in individual cases is zero.

As in the case of credit, fertiliser supply differed markedly between the delta and the middle and upper valley. In the delta, fertiliser availability does not seem to have been a problem for farmers growing the 1988 rainy season rice crop. The concentration of farmers, and relatively easy access (300 km by tarmac road) to Dakar, present traders with a good prospect of finding buyers for large consignments of fertilisers. In the middle valley, however, irrigated perimeters are small and dispersed, and access is limited by bad roads which may become impassable during the rainy season. So trading incentives are fewer. In He à Morphil, for example, the local SAED administration had to intervene to secure fertiliser supplies in the 1988 rainy season. However, the SAED director in Ile à Morphil feels that in future individual PIVs will need to combine their fertiliser orders and delivery points in order to make the deal sufficiently attractive to traders.

Therefore, after the first season of SAED withdrawal there has been a fairly ready development of commercial trade in fertilisers and pesticides in the delta, but not in the middle valley. Overall, there is no evidence of declining fertiliser use in irrigated agriculture, but there is a great deal of variability in fertiliser use which seems to reflect farmers' assessment of the potential productivity of their crop. Two key factors condition this potential: firstly, the reliability of irrigation, and, secondly - relevant in the delta rather than in the middle valley - the availability of agricultural machinery.

4.4 Machinery Use

Mechanised tillage has always been practised on the large perimeters of the delta. In the middle valley farm machinery has been less important because of the small plot size (0.2 - 0.3 ha) and the lighter texture of the soils. The large plot size of the new "intermediate" perimeters now coming into production makes it likely that the impact of mechanised tillage will soon be more widely felt in the middle valley, but the following remarks refer principally to the delta.

The withdrawal of SAED from the provision of agricultural machinery was implemented through two procedures. Firstly, equipment operation and maintenance was centralised under the new organisation called "Unite" Atelier Central (UAC) at Ross Bethio to improve efficiency and to prepare for privatisation (SAED, 1986). Secondly, maintenance to the tractor fleet was reduced in order to allow commercial tractor hire to take over. In the 1988 rainy season UAC estimated that about 85% of tillage in the delta was undertaken by private tractor operators (approximately 10,700 ha). About 60% of this was financed with CNCAS credit.

Although many individuals and organisations in the delta operate tractors, the bulk of the hiring is done by a few companies. One of these, SOGEC based in St Louis, operates a fleet of four tractors which were hired to cultivate a total of 3,700 ha for the 1988 rainy season. This corresponds to almost a third of the area cultivated in the delta. By comparison, SAED has some 30 tractors currently out of service awaiting repairs prior to transfer to the private sector. The precise form of such transfer was still under study in 1989, but two consequences may be identified. Firstly the eventual re-entry into service of this equipment will have a major impact on the hire market. Indeed, SOGEC managers stated that they were unwilling to expand their own fleet until the future of the SAED fleet had become clear. Secondly, the existing equipment for hire is extremely scarce, which makes it more difficult for farmers to carry out tillage at exactly the right time.

Timing of tillage is critical because it must take place before the release of irrigation water into the main canals, usually timed for late July or early August. Tillage carried out too early carries the risk of weed growth in the fields following early rains in July. This, coupled with the shortage of tractors, has placed a strong emphasis on speed in tillage operations. As a result, ploughing - harrowing practices have been abandoned in favour of a single pass with an offset disc harrow. This may have a detrimental effect on rice output. Several of the farmers interviewed lamented that they would prefer to plough their fields. Although twice as expensive, ploughing would deal more effectively with perennial weeds, and in particular the *riz au rhizome* (*Oryza longistaminata*) which had become so bad that whole fields had been abandoned to it⁴. Other farmers, notably in Thilene, pointed to reduced drainage as a more fundamental factor causing weed infestation. This can also keep the soil too wet for mechanised cultivation.

Until the SAED tractor fleet has been finally transferred to private hands, it will not be possible to see the final pattern of machinery use. A preferred option appears to be to equip the *Sections Villageoses* with their own machinery for hire to their own members, along the lines followed with some success for five years by the "Sections d'Utilisation de Machines Agricoles" (SUMA) on the Nianga perimeter (Podor). However, it is clear that irrigation and drainage conditions will have a major impact upon the efficiency of machinery use.

4.5 Irrigation

Within the plans for SAED withdrawal, no timescale has been established for the transfer of irrigation water management to the private sector. Instead, SAED began a three-year programme in 1987 to charge farmers the "true cost" of its services. The role of SAED in the supply of irrigation differs between large perimeters and the PIVs. On the PIVs of the middle and upper valley SAED carries out the maintenance and supplies spare parts for the diesel pumpsets which supply water from the river. Farmers' organisations pay for the cost of all parts and materials (oil, filters, etc) but

⁴ Research by WARD/ADRAO indicates that the offset harrow may in fact be quite effective in controlling this weed, but only if used twice, with an interval sufficiently long to allow the drying out of the rhizomes and their physical removal from the field (van Brandt, 1982). In short, a practice which requires considerable time and labour.

not for the mechanic's time. By 1989 there was no stated change in this policy.

On the large perimeters SAED has a more central role, with responsibility for operation and maintenance of the large pumping stations and the main water distribution and drainage canals. For this service farmers pay a fixed charge each growing season, which was increased in 1985 from 25,000 fr CFA/ha to 41,000 fr CFA/ha for rice. This increase coincided with a reorganisation which shifted the operation and maintenance of water supply from perimeter level, to delegation level. In practice this only affected the large perimeters in the delta, as the two large perimeters in the middle valley, Nianga and Guedé, were allowed to retain their autonomy.

In the delta a Unité de Gestion d'Eau (UGE) was formed, with two principle divisions based at Ross Bethio. The "Gestion Hydraulique" has responsibility for planning water distribution and invoicing farmers, and the "Exploitation" division was charged with operation and maintenance of the large (electric) pumping stations supplying the canal network, and with planning the annual programme of canal maintenance. However, the execution of canal maintenance was to be contracted out to another new Unité based at Ross Bethio. The l'Unité de la Régie d'Aménagement et d'Entretien (URAE), was awarded all the canal maintenance equipment previously under the control of individual perimeter management. As with the formation of UAC, the centralisation of earthmoving machinery into a central URAE appears to have been motivated partly by a desire to improve the efficiency of equipment use and partly by the intention of forming a unit suitable for privatisation.

However, the outcome for canal maintenance appears to have been little short of disastrous, with weed growth so serious in the principle drains that farmers at Thilene (Lampsar) complained that their cultivable area was reduced by waterlogging. At Debi Mboundoum perimeter some 400 ha were so waterlogged that the rice crop could not be harvested. Under these circumstances SAED has acknowledged that it can hardly expect farmers to pay the "true cost" of canal maintenance - commonly given as 30,000 fr CFA/ha in addition to the existing 41,000 fr CFA/ha charge - which SAED is unable to guarantee will be carried out (SAED, 1986). It is not clear whether reduced activity by the URAE reflects competing commitments in irrigation construction or shortfalls in funding after the fall of the dollar in 1985.

4.5 Rice Marketing

The major step taken in marketing is to transfer to farmers the responsibility for loading and transport of paddy to the mills. SAED remains in charge of the three rice mills in the Senegal river valley, pending their refurbishment and transfer to the private sector. In principle SAED only buys rice delivered to the mills. However, this principle is fully implemented only in the delta, where the farmers' organisations record the amounts marketed by individual members, and organise bagging and transport to the mill. Withdrawal has not been implemented with the PIVs due to transport scarcity and the relatively small quantities of paddy marketed by individual villages. On the Ile a Morphil, for example, SAED buys paddy in the villages and undertakes the transport to the mills.

SAED purchases paddy for 85 fr CFA/kg, payment being made 10-14 days later. This price, increased from 66 fr CFA/kg in 1985, leaves practically no milling margin with the consumer price fixed at 130 fr CFA in April 1988, and thus reduces the attractiveness to commercial traders. This, together with prompt payment in recent years, has sharply increased the percentage of paddy marketed through SAED. SAED is able to pay the higher price for paddy because it receives 180 fr CFA/kg for milled rice (38% above the consumer price) from the government Caisse de Péréquation et de Stabilisation des Prix, which in turn finances its purchases from profits made on handling cheaper imported rice.

4.6 An Overview of Disengagement

Where the withdrawal process has advanced most, as in the provision of credit, agrochemicals supply and rice marketing, there has developed a discernable advantage in favour of the delta, where communications are better. Here, a market in agrochemicals supplied by commercial traders has effectively been established, although all the cost of credit for this trade is paid (at 14% interest) by farmers. In the middle valley, however, the privatisation process has not yet generated a commercial alternative to intervention by SAED or development agencies, particularly for the PIVs. Where state withdrawal has been less complete, as in farm machinery rental and in the operation and maintenance of irrigation, there is evidence that the pre-privatisation reorganisation of SAED has resulted in a deterioration and greater scarcity of provision of these services. This is particularly apparent on large perimeters, where inequity in access to water and, to a lesser extent, machinery, can be seen to cause great disparity in agricultural productivity.

In the following section we will discuss how these changes have influenced trends in irrigated farming systems in the delta and middle valley, and assess whether the "disengagement" of the state is likely to achieve its objective of promoting a rapid increase in irrigated food output from the Senegal river valley.

5. IRRIGATED FARMING FOLLOWING STATE DISENGAGEMENT

5.1 Effects on Farmers' Irrigation Organisations

Table 1 shows how the distribution of irrigated area between different types of perimeters has changed over time.

TABLE 1: Net irrigable area (ha) in totals for different types of perimeter

Year	1976	1980	1984	1987	1988
large perimeters	7083	9465	12577	12989	12940 ha
small perimeters (upper/middle valley)	352	3577	7271	11991	12783 ha
small perimeters (delta)	691	1191	2191	4315	5853 ha
Total	8126	14233	22039	29295	31576 ha

Source: OMVS 1988

Table 1 shows that the area of large perimeters remained static between 1984 and 1988. However, small-scale irrigation has extended, and now accounts for more than half of the total irrigated area on the southern bank of the Senegal river. Although the largest absolute increase in small-scale irrigation took place in the middle and upper valley, the fastest expansion rate (160% in four years) was in the delta, where small diesel pumpsets now irrigate an area corresponding to 45% of the total surface under large-scale irrigation. This is of particular interest because the organisations responsible

for these small perimeters are generally *non-encadre*, that is, outside the responsibility of the SAED. This sector, which the policy of state withdrawal is intended to encourage, is made up of three different forms of organisation, which are distinct from the *Sections Villageoises* on SAED perimeters. They are: *foyers*, *groupements d'intérêt économique* (GIE), and private farmers. The private farmers are often urban-based and/or have trading activities. Their farming interest centres on high-value fruit and vegetable production. The *foyers* and GIE seem more based in rural communities, and more concerned with growing rice. The GIE are a variable form of organisation, the name being widely applied to any form of cooperative or business partnership (on closer inspection some GIE have occasionally been found to have only one member). In the three cases visited on the Grand Digue-Tellel-Kassak perimeter, the formation of a GIE to run small-scale irrigation was a means whereby wealthier members of the *Section Villageoise* provided access to irrigated land for their less wealthy or landless relatives.

The role of irrigation infrastructure in establishing "irreversible" land tenure was noted earlier in the context of the middle valley. It is possible to see in the recent proliferation of small-scale irrigation in the delta a similar and accelerating struggle for land tenure in which wealthy individuals from urban areas are active.

Many younger people participating in new irrigation through *foyers* or GIE are members of families which have plots in large perimeters. Therefore, a multiplicity of irrigation organisations may exist within a single village. The example of the village of Thilene may illustrate this. The village has a *Section Villageoise* with 66 members with rights to farm 105 ha of irrigated land within the (large-scale) Lampsar perimeter run by SAED. The village youth association (*foyer*), formed in 1976, acquired a perimeter of 20 ha, irrigated with a diesel pumpset and with infrastructure constructed with SAED assistance in 1981. This was subsequently extended to 30 ha and farming diversified to include tree plantations, bananas and market gardening, as well as rice production. In 1987 the SV and the *foyer* both invested in another small perimeter of 35 ha, on which 32 participants occupied plots of 0.5 - 1 ha each to grow rice in the 1988 dry season. Significantly, the arrangements for credit (with CNCAS), input supply (with traders), and rice marketing (with SAED) are formally handled for all three irrigation organisations in Thilene village by the SV. In this case the organisation of small-scale irrigation adjacent to the large schemes may be thought of as constituting additional autonomous *groupements* which use a single village-level entity (the *Section*) to administer commercial transactions.

It is not clear that such a close link between large-scale and small-scale irrigation exists in all other villages, but the emergence of such an organisation suggests that the disengagement of SAED has added a logic of financial administration to the logic of organisation for water management. Thus, a distinction is emerging on large perimeters between the *groupement*, concerned primarily with irrigation management on areas of 15 - 30 ha, and the *section*, concerned with administering the commercial activities of farmers at village level, thus embracing several *groupements*. A further development along the same lines is the SUMA on the Nianga (Podor) perimeter, where the *section* also has responsibility for operating and hiring agricultural machinery.

The separation of day-to-day irrigation management from input supply and crop marketing finds echoes in developments in the middle and upper valley: a regional federation of small-scale irrigation groups in the Bakel area; the proposal by a SAED director that villages on the Ile a Morphil should collaborate in groups of 10 - 15 to improve their bargaining power with traders and transporters. Evidently, such collaboration between villages will be more difficult than the administration of the same activities within a single village, but there may be no alternative if input supplies are to be secured, given the lack of interest on the part of traders.

However, there are two features of the disengagement process which may open the way for greater differentiation among farmers within the same *groupement*. Firstly, the available evidence indicates that present systems of distribution of water within the *groupement* do not ensure equity.⁵ It is not uncommon for one or more members of a *groupement* on either large or small perimeters to lose their crop entirely because of inequitable water distribution within the *groupement*. With the advent of collective responsibility for loan repayment, such inequity in irrigation is translated into indebtedness of disadvantaged farmers towards other members of the *section*. Failure to pay these debts can and does result in the debtors' loss of cultivation rights, which are generally taken over by somebody prepared to pay off the outstanding debt. The question of whether such a process is leading to the accumulation of cultivation rights in the hands of fewer landholders requires further detailed study.

⁵ A discussion of inequitable water distribution in formally equitable water supply systems can be found in Woodhouse and Ndiaye (1990).

Secondly, the scope for inequitable accumulation is enhanced by reduced availability of both land and water caused by the deterioration of main canals on large perimeters in the delta, seen as a result of disengagement by SAED.

5.2 Production Costs

A detailed summary of production costs is given in our earlier paper (Woodhouse and Ndiaye, 1990), from which we have drawn the main points presented here.

Using data from interviews with farmers and from secondary sources, our study attempted to calculate the costs of production (defined as cash costs, i.e. excluding family labour) in relation to different levels of crop yield. For this purpose, a high paddy yield was considered to be over 4.5 t/ha and a low yield under 2.25 t/ha.

On large perimeters, average production costs on high yield plots accounted for 42% of yield value in 1989 compared to 26% in 1982/83. Agrochemicals and harvest expenses have caused the bulk of this increase. However, our study also suggests that, in addition to rising production costs, low yields are a widespread source of low returns on large perimeters. On low yield holdings, production costs were equivalent to about 90% of the crop value, compared to 42% on high yield holdings, despite the fact that 77% more was spent per hectare on inputs on high yielding holdings. This reflects the effect of elements such as water and tractor hire, whose cost is fixed but the efficiency of which is crucially determined by timing. The possibility of low yields seems to have been ignored in most studies of rice production costs, which assume that yield is dependent on input level alone, and ignore constraints on input effectiveness once supplied.

The production costs of new PIVs in the delta are variable depending on whether pump amortisation is included; but figures suggest that while this irrigation is not cheaper it may be more reliable than on large schemes. With PIVs elsewhere, evidence suggests that production costs have remained more stable in relation to yield value, rising by about the same proportion as paddy prices. This reflects lower commitment in inputs and mechanisation. However, far less data is available. In the mid-yield range (3.5 - 4t/ha) production costs were 25 - 33% of crop yields in 1989 on the Ile a Morphil. Engelhard et al (1986) cited a ratio of 18% on PIVs in 1982/83, but for a high-yield level (5t/ha).

Thus, this study indicates that the greatest problems for farmers occur not in the area of prices but in avoiding a disastrous drop in yields. Variation in water management plays a central role in determining agricultural performance of individual farmers on both large and small perimeters. The disengagement of SAED has resulted in a deterioration in the delivery and drainage of water on large irrigation schemes, which has increased the incidence of unfavourable moisture conditions, and hence increased the number of farmers experiencing low yields.

5.3 Effects on the Productivity of Irrigation Infrastructure

Table 2 compares the irrigable area and the area cultivated for rice production in the years 1984 and 1987.

TABLE 2: Irrigable area and area sown with rice in 1984 and 1987, Senegal river valley, left (Senegalese) bank

Agricultural year, starting July	1984	1987
total irrigable (ha)	21973	29295
area sown in rainy season	16959	13883
area sown in hot dry season	465	3852
total rice area	17425	17735
rice area as % of irrigable area	79%	60%

Source: OMVS and SAED

It indicates that the rice area has remained static, and this underlies the relatively small (10%) increase in rice production over the period. However, Table 2 also shows that rice area is declining as a proportion of the total irrigable area, and is increasingly distributed over the two growing seasons. There are two principle reasons for this overall pattern. Firstly, the major redistribution of rice growing from rainy season to dry season is the direct consequence of the completion of the Manantali dam. This dam, together

with the barrage at Diama, now ensures a year-round supply of fresh water for irrigation in the delta. Thus, the spread of rice cultivation to the dry season is an anticipated outcome of *l'Apris-barrage*. However, the decline in rice area relative to the total irrigable area indicates a second, unanticipated effect: that land is being used less intensively. This shift in cultivation intensity shows farmers on large schemes in the delta to be following a pattern of farming apparent several years earlier on the PIVs of the upper and middle valley, where dry season irrigation has always been more common than in the delta. To illustrate this land use pattern more clearly, Table 3 sets out the cropping history of different perimeters visited in 1989, for the previous three seasons.

TABLE 3: Proportion of land cultivated in three successive seasons in different irrigation perimeters, Senegal river valley

Season and starting month	cool dry nov 87	hot dry mar 88	rainy July 88	total	
Perimeter	net irrigable	% of area cultivated, and crop			
SV Diagambal (Lampsar)	350 ha	11% tomato	55% rice	27% rice	93%
Guedé	343 ha	44% tomato	16% rice	43% rice	103%
Ile a Morphil Zone Demet (18 PIVs)	421 ha	40% maize	16% rice	65% rice	121%
Zone P6té (22 PIVs)	454 ha	1% maize	36% rice	22% rice	59%

Source: Woodhouse and Ndiaye, 1990.

The table gives two examples from large perimeters (Diagambal and Guedé) and two of irrigation organised in PIVs. With one exception, the irrigable land is fairly completely used during the year, but is not all cultivated at the

same time. Instead, part of the area is cultivated each season. In the case of the PIVs in the He à Morphil, it is more usual for an entire perimeter (15 - 40 ha) to be cultivated in any one season. However, since a single village often has more than one perimeter, production may be undertaken in different perimeters in successive seasons. We can note that within this system farmers may also switch in and out of cultivation of rainfed crops (in the upper valley) or flood-recession cultivation of the *cuvettes* (in the middle valley), whenever rainfall is sufficient.

It is important to note that this multi-season farming does *not* correspond to the double cropping (two crops per year from the same land) which *I'Aprtis-barrage*, through year-round provision of irrigation, was intended to promote.

Bastiaansen (1988) links the decline in intensity of land use in the Ile a Morphil to the increase in price of inputs in the early 1980s, which he feels was a disincentive to produce rice and which encouraged farmers to grow a cheaper (but less productive) crop of maize, particularly on lighter soils. However, there is evidence that farmers in the middle valley are also interested in maize and sorghum because they provide better livestock fodder than rice straw. Dry-season livestock fodder in the Sahel is more valuable than planners of irrigated crop production have recognised: farmers in Dioudé Diabé (He à Morphil) claimed that the sale of a single sheep could pay the pumping and fertiliser costs of growing rice on a 0.2 ha plot on their PIVs.

As discussed, production costs did increase relative to the value of the rice crop, particularly in the delta, but without much reduction of input use. More fundamental factors appear to block the more intensive use of land.

Firstly, double-cropping creates intense labour bottlenecks. Secondly, water management is insufficiently coordinated at local level to allow tillage of the soil within the very tight timetable required by double cropping. Studies by ISRA (Le Gal, 1989) indicate that the harvest of the 1987 rainy season rice crop took four months from the start of the first field to the completion of the last, using seasonal hired labourers and diesel-powered threshers. Dokit Thonon and Bruyère (1988) have suggested that complete mechanisation of the rice harvest may be the only way to resolve the bottlenecks presented by double-cropping. In practice, farmers, unlike development finance agencies, are not primarily preoccupied with maximising the annual output from each plot of land, but rather with maximising the return on their investment of labour and cash in production. The advantage to farmers of dividing their land and cultivation over more than one season is that one

crop need not be cleared before the next crop is planted. This allows (particularly family labour), to be used more flexibly and reduces the need for extra seasonal labour⁶.

Another poorly-studied problem is the need to synchronise farming operations in adjacent fields, so that drainage can be carried out in time to dry the soil sufficiently to allow tillage for the next crop. Such synchronisation is difficult if irrigation rotations create a substantial interval between the establishment dates of crops in adjacent fields. The need for tighter local coordination of farm operations (i.e. at *groupement* level) implied by double rice cropping may therefore call into question the existing practice of water supply on large perimeters in the delta. Further, the deterioration in canal maintenance which has accompanied SAED disengagement has greatly reduced the control of water delivery and drainage on large perimeters. This, coupled with the scarcity of agricultural machinery, severely diminishes the prospect of double-cropping on large perimeters.

A final point on the productivity of irrigation concerns the proliferation of small-scale irrigation in the delta, whose construction, while cheap, is also rudimentary. Small perimeters constructed without drainage will increase the risks of secondary salinisation of the saline delta soils, especially when situated on the periphery of large perimeters whose own drainage system has deteriorated. Avoidance of this risk requires both a regulatory body to enforce adequate drainage measures, and engineers with the necessary skills and experience to advise farmers' organisations on irrigation design. The plans for the withdrawal of SAED as yet have no concrete proposals on this last point.

5.4 Summary

In our discussion of irrigated farming in the aftermath of state disengagement, we have tried to identify the main institutional and technological factors at work in a complex, diverse, and rapidly changing situation.

As a result of SAED disengagement, farmers' organisations have become responsible for arranging credit, input supplies, and marketing of the crop,

⁶ Seasonal labourers from the regions to the south of the river valley are already employed in large numbers to harvest the rice crop, particularly the delta.

and this has created pressure towards collaboration between irrigation groups in order to improve their bargaining power with the credit agency, CNCAS, input suppliers, and transporters. This trend effectively reinforces throughout the valley the two-tier model of organisation set up by SAED on large perimeters in 1984. In this model, a *section* coordinates the activity of a number of water management *groupements*. The development of a commercial input supply system is financed by credit paid for by farmers. The credit is unsecured, but the collective responsibility of farmers within a *section* for repayment of the loans offers a guarantee of repayment. However, this arrangement also provides a mechanism by which indebtedness may grow *within* a *section*, with the prospect of wealthier members eventually buying out the cultivation rights of indebted members.

This potential for loss of cultivation rights has increased on large perimeters with the deterioration of infrastructure, which has increased the risk of crop failure within a relatively rigid cost structure. On the small-scale perimeters of the middle valley, there is less potential for this to occur because farmers generally have a more diverse income base, lower cash requirements for production costs, and individual *groupements* have greater control over the water delivery system. However, on new intermediate-scale perimeters currently being constructed in the middle valley larger plot sizes will make mechanisation necessary, and the need to share pumping equipment with other *groupements* will make conditions similar to those on the large perimeters of the delta in the longer term.

The generalised lack of double cropping on both large and small perimeters is attributed to intense labour peaks coupled with lack of appropriate mechanisation. The disengagement of SAED has done nothing to relieve this, and to some extent has made it worse. In the middle valley delays in planting have resulted from difficulties in obtaining credit or inputs; in the delta the deterioration in canal maintenance and reduced availability of tractors - both traced to measures to prepare for privatisation - have further limited farmers' capacity for timely land preparation and planting. The unregulated proliferation of small-scale irrigation by private sector investment in irrigation, raises the prospect of further cultivation difficulties due to inadequate drainage provision and soil salinisation.

Development of irrigation infrastructure has become the principal effective method of transfer of land tenure in the Senegal river valley, provoking the formation of irrigation organisations to gain access to irrigated land for different social groups within the communities of the valley. Under structural adjustment measures this competition for irrigated land has been greatly sharpened by government encouragement to entrepreneurs from

outside the valley to seek land allocations from rural councils. The ensuing tension was documented in 1988, in reports in the Senegalese press⁷ that competition for land increasingly set the interests of one village against another, leading to violent confrontations between villages on both the Senegalese and Mauretian sides of the river valley. In April 1989 tensions over land rights exploded after two Senegalese farmers were killed by the Mauretian military during a dispute over grazing rights. In the weeks that followed, rioting in Nouakchott and Dakar left several hundred dead, and, amid mutual repatriations of Senegalese and Mauretians, some 60,000 farmers were expelled from the northern (Mauretian) bank of the Senegal river valley to the southern bank, where they remain as refugees to the present.

The early experience of state disengagement from irrigated agriculture in the Senegal river valley indicates that, in contrast to rainfed farming in Senegal (Commander et al, 1989), an irrigated food-farming sector can sustain a commercial input supply system, under conditions of good access (i.e. in the delta) and where the cost of credit is met by farmers. In the less accessible areas of the middle and upper valley it seems likely that farmers' associations will need to bear much of the organisational, as well as financial, burden of securing input supplies.

The hoped-for growth of cereal output through the production of two rice crops on the same land each year in the delta has for the most part not materialised, due to insufficient mechanisation and inadequate and deteriorating irrigation infrastructure. As a result rice production has remained static, despite a rapid increase in the area of irrigated land. While commercial enterprises might in time ease the mechanisation constraint, it is by no means clear that they would improve irrigation infrastructure, whose decline is at least partly attributable to the disengagement process itself. Progress in the liberalisation of markets for agricultural inputs and services seems therefore to be constrained in various ways by inadequate infrastructure - an issue which appears unlikely to be resolved simply by disengagement of the state.

Similarly, our analysis suggests that disengagement will not achieve the intensification of land use through double cropping, which the government hoped would provide the increase in production needed to reduce rice imports. However, a further consequence, of more immediate relevance to the farmers of the Senegal river valley, is that the persistence of single

⁷ SudHebdo, nos 23 (20.10.88), 24 (27.10.88), and 25 (3.11.88).

cropping of the land will sustain the pressure to increase production through extension of the area under irrigation schemes, which will further inflame the competition for land tenure. The events of 1989 have demonstrated how dangerous such an outcome may prove to be.

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